

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Dr. Andreas WEICKENMEIER

Art Unit:

Serial No.:

Examiner:

Filed: March 1, 2002

Title: PARTICLE-OPTICAL LENS ARRANGEMENT AND METHOD
EMPLOYING SUCH A LENS ARRANGEMENT

Assistant Commissioner for Patents
Washington, DC 20231



22511

PATENT TRADEMARK OFFICE

PRELIMINARY AMENDMENT

Dear Sir:

Before examining the referenced application on the merits, please amend the application as outlined below:

IN THE ABSTRACT

Please delete the abstract and replace with the following paragraph:

--(New) The present invention discloses a lens arrangement for the particle-optical imaging of an object to be imaged and positionable in an object plane into an image area. In one embodiment, the lens arrangement includes a first focusing lens device for providing a field having a focusing effect on the imaging particles for imaging the object from the object area into an intermediate image area, a second focusing lens device for providing a further field having a focusing effect on the imaging particles for imaging the object, which has been imaged into the intermediate image area, into the image area, and a deflection lens device for providing a field having a deflecting effect on the imaging particles in a region of the intermediate image area.

The deflection lens device is disposed in the intermediate image area primarily to compensate for aberrations, such as image field curvature.--

IN THE SPECIFICATION

Please amend the Specification as follows (a copy of the marked up paragraphs is attached as appendix A):

On page 1, line 1, please insert the heading --FIELD OF THE INVENTION--

On page 1, line 11, please insert the heading --BACKGROUND OF THE INVENTION--

On page 3, line 12, please insert the heading --SUMMARY OF THE INVENTION--

On page 8, line 27, please insert the heading --BRIEF DESCRIPTION OF THE DRAWINGS--

On page 9, line 17, please insert the heading --DETAILED DESCRIPTION--.

Please amend the paragraph that begins “Figure 3” on page 8, line 35, as follows:

(Amended) Figures 3A-3C depict different types of coils of a deflection lens device shown in Figure 2,

Please amend the paragraph that begins “Figure 4” on page 9, line 1, as follows:

(Amended) Figures 4A-4C depict different arrangements of current conducting windings of the deflection lens device shown in Figure 2 around the circumference of a ferrite ring,

Please amend the paragraph that begins on page 9, line 14, as follows:

(Amended) Figures 7A-7C show several representations for illustrating the aberration-reducing effect of the lens arrangement according to the invention.

IN THE CLAIMS

Please amend the claims as follows (a copy of the marked up claims is attached as appendix B):

1. (Amended) A lens arrangement for the particle-optical imaging of an object, to be imaged and positionable in an object area, into an image area, comprising:

a first focusing lens device for providing a field having a focusing effect on the imaging particles for imaging the object from the object area into an intermediate image area,

a second focusing lens device for providing a further field having a focusing effect on the imaging particles for imaging the object, which has been imaged into the intermediate image area, into the image area, and

a deflection lens device for providing a field having a deflecting effect on the imaging particles in a region of the intermediate image area.

2. (Amended) The lens arrangement according to claim 1, wherein the field of the first focusing lens device comprises at least one field selected from the group consisting of magnetic and electric field which is substantially axially symmetric in respect of a central beam of a bundle of beams.

3. (Amended) The lens arrangement according to claim 1, wherein the field of the first focusing lens device comprises at least one field selected from the group consisting of two magnetic, electric dipole, and quadrupole field

arrangements which are axially spaced apart from one another in respect of a central beam of a bundle of beams of the imaging particles.

4. (Amended) The lens arrangement according to claim 1, wherein the field of the deflection lens device comprises a magnetic field which is substantially mirror-symmetric in respect of a plane jointly extending with a central beam of a bundle of beams of the imaging particles.

5. (Amended) The lens arrangement according to claim 1, wherein the field of the deflection lens device comprises at least one field selected from the group consisting of magnetic and electric dipole field which is oriented transverse to a central beam of a bundle of beams of the imaging particles.

6. (Amended) The lens arrangement according to claim 1, wherein an aperture stop is provided in at least one diffraction plane of the first focusing lens device and the second focusing lens device.

7. (Amended) The lens arrangement according to claim 1, further comprising a first driving means for the deflection lens device for adjusting a strength of the deflecting field thereof, and a second driving means for adjusting a strength of the focusing fields in at least one of the first focusing lens device and the second focusing lens device, wherein the first driving means changes the field strength of the deflection lens device substantially proportionally dependent upon an external magnitude and the second driving means changes the field strength of the first focusing lens device and the second focusing lens device, respectively, substantially quadratically dependent upon the external magnitude.

8. (Amended) The lens arrangement according to claim 7, wherein the lens arrangement is provided for imaging a subfield of the object area which is spaced apart from the optical axis of the lens arrangement by a variable distance onto the image area, and wherein the external magnitude comprises the distance of the subfield from the optical axis.

9. (Amended) The lens arrangement according to claim 8, wherein the field of the deflection device deflects pairs of different beams of the particle beams imaging the subfield at substantially equal angles.

10. (Amended) The lens arrangement according to claim 8, further comprising an illumination device for illuminating merely the subfield of the object area and a third driving means for the illumination device for driving the illumination device in order for the distance of the illuminated subfield from the optical axis to be changed.

11. (Amended) The lens arrangement according to claim 8, wherein the image area and the object area each have a predetermined nominal shape, wherein the second driving means changes the strength of the deflecting field of the first and the second focusing device, respectively, such that a central region of the subfield is imaged substantially sharply onto the image area, and wherein the first driving means changes the strength of the deflecting field of the deflection lens device such that the peripheral regions of the subfield are also imaged substantially sharply onto the image area.

13. (Amended) Method for device manufacture, comprising: a photolithographic step, wherein the photolithographic step comprises the transfer of a pattern defined by a mask to a particle-sensitive substrate using a lens arrangement, the lens arrangement comprising:

a first focusing lens device for providing a field having a focusing effect on the imaging particles for imaging the object from the object area into an intermediate image area,

a second focusing lens device for providing a further field having a focusing effect on the imaging particles for imaging the object, which has been imaged into the intermediate image area, into the image area, and

a deflection lens device for providing a field having a deflecting effect on the imaging particles in a region of the intermediate image area; and wherein the mask is disposed in the object area and the substrate is disposed in the image area.

Please add the following new claims:

14. (New) The lens arrangement according to claim 1, wherein the field of the second focusing lens device comprises at least one field selected from the group consisting of magnetic and electric field which is substantially axially symmetric in respect of a central beam of a bundle of beams.

15. (New) The lens arrangement according to claim 1, wherein the field of the first and the second focusing lens device comprises at least one field selected from the group consisting of magnetic and electric field which is substantially axially symmetric in respect of a central beam of a bundle of beams.

16. (New) The lens arrangement according to claim 1, wherein the field of the second focusing lens device comprises at least one field selected from the group consisting of two magnetic, electric dipole, quadrupole field arrangements which are axially spaced apart from one another in respect of a central beam of a bundle of beams of the imaging particles.

17. (New) The lens arrangement according to claim 1, wherein the field of the first and the second focusing lens device comprises at least one field selected from the group consisting of two magnetic, electric dipole, and quadrupole field arrangements which are axially spaced apart from one another in respect of a central beam of a bundle of beams of the imaging particles.

REMARKS

The claims have been amended to remove multiple dependencies and to correct antecedent basis errors. No amendments have been made for reasons relating to patentability. No new matter has been introduced by way of this amendment. Full examination and favorable action are requested.

Please charge any fees, or make any credits, to Deposit Account No. 50-0591, Reference No. 03850.017001.

Date: 3/1/02

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APPENDIX B: MARKED UP CLAIMS

Please amend the paragraph that begins “Figure 3” on page 8, line 35, as follows:

(Amended) Figures 3A-3C depict[s] different types of coils of a deflection lens device shown in Figure 2,

Please amend the paragraph that begins “Figure 4” on page 9, line 1, as follows:

(Amended) Figures 4A-4C depict[s] different arrangements of current conducting windings of the deflection lens device shown in Figure 2 around the circumference of a ferrite ring,

Please amend the paragraph that begins on page 9, line 14, as follows:

(Amended) Figures 7A-7C show[s] several representations for illustrating the aberration-reducing effect of the lens arrangement according to the invention.

APPENDIX B: MARKED UP CLAIMS

The material that has been deleted from the claims is shown in boldface text within brackets. Newly added matter is underlined.

1. (Amended) A lens arrangement for the particle-optical imaging of an object [(23)], to be imaged and positionable in an object area [(27)], into an image area [(31)], comprising:

a first focusing lens device [(55)] for providing a field having a focusing effect on the imaging particles for imaging the object [(23)] from the object area [(27)] into an intermediate image area [(59)],

a second focusing lens device [(57)] for providing a further field having a focusing effect on the imaging particles for imaging the object [(23)], which has been imaged into the intermediate image area [(59)], into the image area [(31)], and

a deflection lens device [(63)] for providing a field having a deflecting effect on the imaging particles in a region of the intermediate image area [(59)].

2. (Amended) The lens arrangement according to claim 1, wherein the field of the first **[or/and the second]** focusing lens device [(55)] comprises at least one field selected from the group consisting of magnetic **[or/]** and electric field which is substantially axially symmetric in respect of a central beam of a bundle of beams [(73)].

3. (Amended) The lens arrangement according to claim 1, wherein the field of the first **[or/and the second]** focusing lens device comprises at least one field selected from the group consisting of two magnetic, **[or/and]** electric dipole, **[or/and]** and quadrupole field arrangements which are axially spaced apart from one another in respect of a central beam of a bundle of beams of the imaging particles.

4. (Amended) The lens arrangement according to claim 1 [**one of claims 1 to 3**], wherein the field of the deflection lens device [(63)] comprises a magnetic field which is substantially mirror-symmetric in respect of a plane jointly extending with a central beam of a bundle of beams of the imaging particles.

5. (Amended) The lens arrangement according to claim 1 [**one of claims 1 to 4**], wherein the field of the deflection lens device [(63)] comprises at least one field selected from the group consisting of magnetic [**or/**] and electric dipole field which is oriented transverse to a central beam of a bundle of beams of the imaging particles.

6. (Amended) The lens arrangement according to claim 1 [**one of claims 1 to 5**], wherein an aperture stop [(61)] is provided in at least one diffraction plane [(61)] of the first focusing lens device [(55)] [**or/**] and the second focusing lens device [(57)].

7. (Amended) The lens arrangement according to claim 1 [**one of claims 1 to 6**], further comprising a first driving means for the deflection lens device [(63)] for adjusting a strength of the deflecting field thereof, and a second driving means for adjusting a strength of the focusing fields in at least one of the first focusing lens device [(55)] [**or/**] and the second focusing lens device [(57)] [**for adjusting a strength of the focusing fields thereof**], wherein the first driving means changes the field strength of the deflection lens device [(63)] substantially proportionally dependent upon an external magnitude [(M)] and the second driving means changes the field strength of the first focusing lens device [(55)] and the second focusing lens device [(57)], respectively, substantially quadratically dependent upon the external magnitude [(M)].

8. (Amended) The lens arrangement according to claim 7, wherein the lens arrangement [(29)] is provided for imaging a subfield [(T)] of the object

area [(27)] which is spaced apart from the optical axis [(41)] of the lens arrangement [(29)] by a variable distance [(M)] onto the image area [(31)], and wherein the external magnitude comprises the distance [(M)] of the subfield [(T)] from the optical axis [(41)].

9. (Amended) The lens arrangement according to claim 8, wherein the field of the deflection device [(63)] deflects pairs of different beams of the particle beams [(73, 75)] imaging the subfield [(T)] at substantially equal angles [α].

10. (Amended) The lens arrangement according to claim 8 **[or 9]**, further comprising an illumination device [(35, 37, 39, 43, 45)] for illuminating merely the subfield [(T)] of the object area [(27)] and a third driving means [(47, 49)] for the illumination device for driving the illumination device in order for the distance [(M)] of the illuminated subfield [(T)] from the optical axis [(41)] to be changed.

11. (Amended) The lens arrangement according to claim 8**[one of claims 8 to 10]**, wherein the image area [(31)] and the object area [(27)] each have a predetermined nominal shape, wherein the second driving means changes the strength of the deflecting field of the first and the second focusing device, respectively, such that a central region of the subfield [(T)] is imaged substantially sharply onto the image area, and wherein the first driving means changes the strength of the deflecting field of the deflection lens device such that the peripheral regions of the subfield are also imaged substantially sharply onto the image area.

13. (Amended) Method for device manufacture, comprising: **[at least one]** a photolithographic step, wherein the photolithographic step comprises the transfer of a pattern defined by a mask [(23)] to a particle-sensitive substrate

[(25)] [by means of] using a [the] lens arrangement, the lens arrangement comprising:

a first focusing lens device for providing a field having a focusing effect on the imaging particles for imaging the object from the object area into an intermediate image area,

a second focusing lens device for providing a further field having a focusing effect on the imaging particles for imaging the object, which has been imaged into the intermediate image area, into the image area, and

a deflection lens device for providing a field having a deflecting effect on the imaging particles in a region of the intermediate image area; and

[(29) according to one of claims 1 to 12], wherein the mask [(23)] is disposed in the object area [(27)] and the substrate [(25)] is disposed in the image area [(31)].